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AND
ANADROMOUS FISH STUDIES

ANADROMOUS FISH STUDIES

AFS-48-3 Joe Wallis and D. Thomas Balland

ALASKA DEPARTMENT OF FISH AND GAME
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TABLE OF CONTENTS

PROJECT NO. AFS-48 ANADROMOUS FISH STUDIES Page

Segment No. AFS-48-3 Anchor River Steelhead Study
By: Joe Wallis and D. Thomas Balland

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

TABLE OF CONTENTS (Cont'd.)

Volume 24 Project No. AFS-48

STATE OF ALASKA

Bill Sheffield, Governor

Annual Performance Report for

ANCHOR RIVER STEELHEAD STUDY

by

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RESEARCH PROJECT SEGMENT

State:	Alaska	Name:	Sport Fish Investigations of Alaska
Project No.:	F-9-15	Project Title:	ANADROMOUS FISH STUDIES
Segment No.:	AFS-48-3*	Segment Title:	Anchor River Steelhead Study

Cooperators: Joe Wallis and D. Thomas Balland

Period Covered: July 1, 1982 to June 30, 1983

ABSTRACT

A downstream migrant trap and minnow traps were used to capture juvenile steelhead trout, Salmo gairdneri (Richardson), coho salmon, Oncorhynchus kisutch (Walbaum), chinook salmon, Oncorhynchus tschawytscha (Walbaum) and Dolly Varden, Salvelinus malma (Walbaum), in Anchor River during the period from May 3 through October 3, 1982. Minnow traps were the most effective in capturing steelhead, but other species were captured effectively in the inclined plane trap.

Relatively small numbers of steelhead smolts were captured throughout the sampling period ending in mid-July, but the greatest catches occurred during mid-May. The mean length of smolts was 149 millimeters (5.9 inches) and they averaged approximately 30 grams in weight.

Thirty-seven adult steelhead were tagged with Floy anchor tags, but inadequate recoveries precluded making a population estimate.

Twenty-one adult steelhead were tagged with radio transmitters in an attempt to monitor instream movements. Several fish were tracked throughout the winter; most of the fish moved comparatively short distances during the period.

A creel census was conducted on the Anchor River in 1982, and an estimated 9,144 angler-days of effort were spent during the period from August 16 through October 31. During this summer-fall fishery, it was estimated that anglers retained only 36 percent of the steelhead they caught for a total harvest of 375 steelhead.

* This report is numbered for sake of consistency, however, this project received no federal dollars this year.

Samples from the adult run were comprised of 13 separate age classes. First-spawning fish were of six age classes. The majority of females were Age Class 3.2. There were about equal numbers of one-ocean and two-ocean fish in the sample of males, with the greatest numbers in Age Class 3.1 and 3.2. Seven separate age classes were represented in a sample of repeat spawners, and repeat spawners comprised 33 percent of the fish sampled.

Analysis of scales from adults provided information on growth rates and size of steelhead smolts which survive to adults. Age II smolts grow faster than Age III smolts, and Age III smolts grow faster than Age IV smolts. It was estimated that the adults had been produced by smolts which averaged about 159 millimeters in length and weighed 36 grams each.

KEY WORDS

Steelhead trout, migrant trap, radio telemetry, tagging, minnow traps, steelhead smolt, Anchor River, spawning.

BACKGROUND

A vicinity map showing location of the study area is presented in Figure 1, and a list of species of fish is presented in Table 1.

In the Cook Inlet area, steelhead trout occur in only a few streams of the lower Kenai Peninsula--Anchor River, Ninilchik River, Stariski Creek, Deep Creek and a limited population in Crooked Creek, a Kasilof River tributary. We have very limited information regarding numbers of fish in these streams, but the total numbers are known to be comparatively small.

The popularity and demand for steelhead fishing in the southcentral Alaska region is growing rapidly. The intensity of angling effort has increased dramatically on these few small streams during the last several years.

Anchor River, the southernmost steelhead stream on the Kenai Peninsula, appears to have the largest run and is the site of the most intense fishery. Fifteen thousand to 20,000 man-days of angling effort annually are spent on the Anchor River in the summer-fall period when steelhead are caught. Dolly Varden, coho salmon and steelhead are all caught during this period and it is not feasible to assign fishing effort to any one species. Total harvest of Anchor River steelhead has ranged from about 400 to 1,700 annually during the past 6 years. This catch has accounted for about 26% to 40% of the total combined harvest of steelhead in the State.

Steelhead stocks in all streams on the Kenai Peninsula are similar to those termed "summer run" throughout the Pacific Northwest. Adults enter the streams throughout the summer and fall, spend the winter in freshwater, then spawn the following spring and migrate back to sea.

Some aspects of Anchor River steelhead life history and population characteristics have been investigated periodically since the mid-1950's, but the studies have been intermittent and of limited scope. Total run size, adult

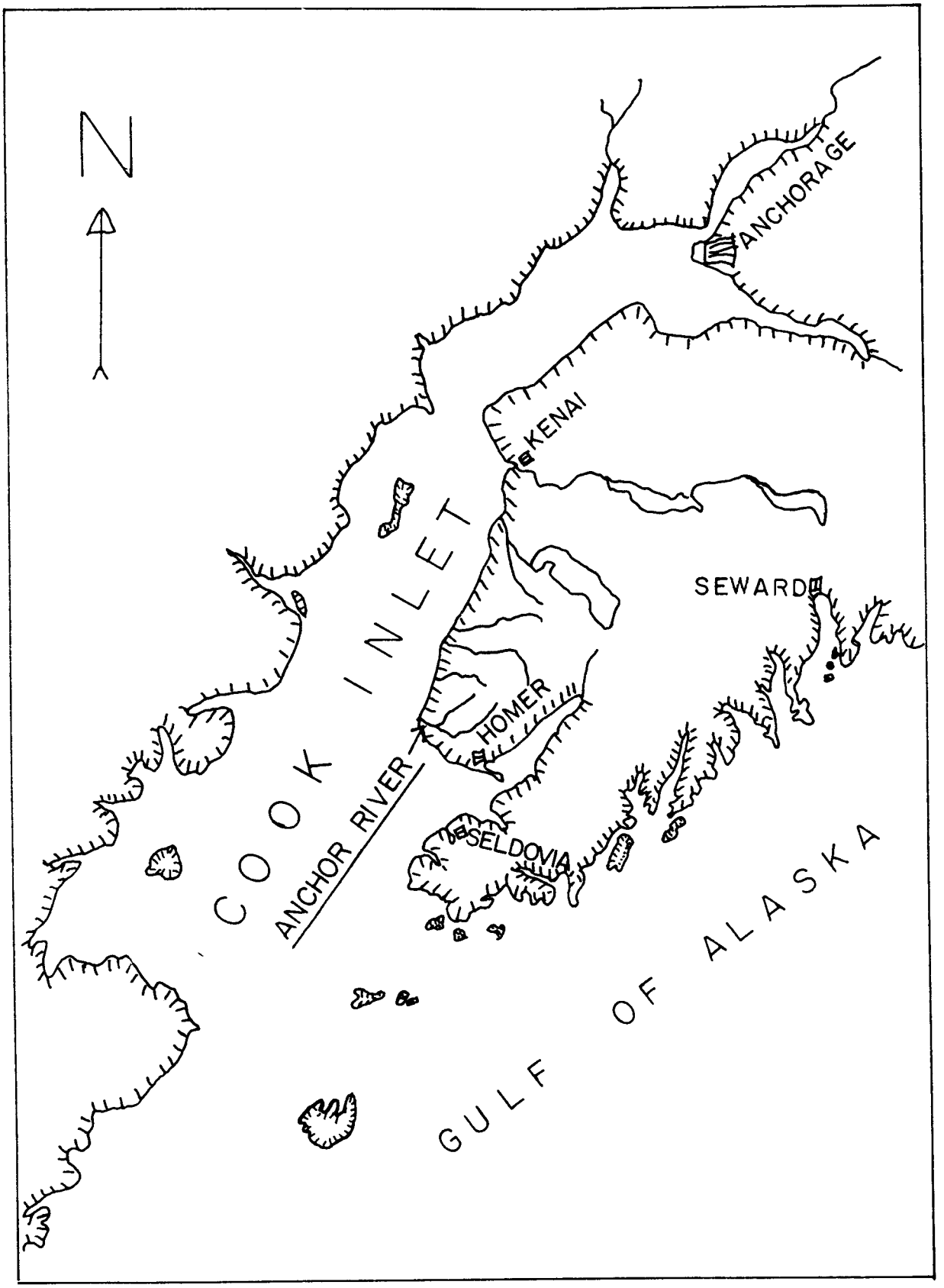

Figure 1. Vicinity map showing location of the study area.

Table 1. List of Common Names, Scientific Names and Abbreviations.

Common Name	Scientific Name and Author	Abbreviation
Chinook salmon	Oncorhynchus tschawytscha (Walbaum)	KS
Coho salmon	Oncorhynchus kisutch (Walbaum)	SS
Dolly Varden	Salvelinus malma (Walbaum)	DV
Rainbow trout	Salmo gairdneri Richardson	RT
Steelhead trout	Salmo gairdneri Richardson	SH

migration and spawning characteristics, areas and timing of juvenile rearing and migration and the potential for supplemental production are a few important aspects which have not been studied adequately.

The stocks of steelhead are entirely naturally produced at present, and it is doubted they can sustain future pressures without harm to the stocks unless additional restrictions are imposed on the harvest or supplemental measures are undertaken.

The Department's goal is to provide continued recreational angling for steelhead on these streams. Its concern is the lack of biological information upon which to base management programs, formulate regulatory guidelines and evaluate the need and potential for supplemental enhancement of these stocks.

This study was initiated to provide information for the Department to use in refining its management program and to provide direction to future enhancement of steelhead stocks.

RECOMMENDATIONS

1. The present objectives of this study should be retained and the study should be continued.

2. As soon as feasible, the scope of the study should be expanded to include definition of characteristics of the steelhead populations in other lower Kenai Peninsula streams.

OBJECTIVES

1. To determine size of steelhead stocks.

2. To determine instream behavior and intrasystem movement and migration.

3. To determine angler utilization and effects of current harvest levels.

4. To determine the need for supplementing steelhead stocks.

TECHNIQUES USED

Water temperatures were recorded with a Ryan-Peabody recording thermograph. The thermograph was positioned on the South Fork of the Anchor River approximately 100 yards above the confluence of the North and South Forks. It was approximately 2 feet from the shore in a minimum of 18 inches of water and was continuously shaded from the sun. Records were continuous from May 25 to October 25, except for 2 days when the recording chart was being changed.

Water flow data were obtained from the U.S. Geological Survey, Water Resources Division. Discharge data have been collected in the Anchor River since June 1953. The present station, 3.3 miles south of Anchor Point on the South Fork of the Anchor River, has been operated since June 1965. The U.S.G.S. water year is from October 1 through the following September.

An inclined plane downstream migrant trap described by Wallis and Balland (1981) was operated intermittently in the South Fork of the Anchor River from May 10 to September 10. On July 5, the trap was modified and, as a result, fished effectively until the end of the season.

Juvenile salmonids were captured at various sites from May 6 to September 28 using handmade minnow traps. The traps were 11 inches in diameter by 18 inches long and were constructed of 4-mesh hardware cloth. During mid-season, minnow traps of standard manufacture, 9 inches in diameter by 16.5 inches long, were incorporated into the trapping schedule. Four minnow trap stations, two on the South Fork and two on the North Fork, were established and fished on a regular basis to help determine the time of smolt migration and instream movements of juvenile steelhead (Figure 2). The two stations on each fork were located several miles apart in an attempt to determine movement of young steelhead between stations. Known presence of juvenile salmonids and ease of access to the sites were factors in determining the location of the trapping stations. Traps were operated during three 24-hour periods each week.

Length measurements were taken to the nearest millimeter from all steelhead juveniles that were caught. At one station all steelhead juveniles were measured and weighed to the nearest 1/10 gram on an Ohaus balance to establish length-weight relationships.

Serially numbered elliptic flutter tags approximately 5 mm long, manufactured by Floy Tag, Inc., were attached to all steelhead juveniles 80 to 129 mm long by means of a vinyl-latex thread tied posterior to the dorsal fin.

Steelhead smolts 130 mm or greater in length were fin-clipped at the upper trapping stations on the North and South Forks of the Anchor River. A right ventral clip was used on the South Fork and a left ventral clip was used on the North Fork.

Scales were collected from all steelhead smolts, all tagged juvenile steelhead and a representative sample of those under 80 mm in length. Collection was from the preferred area posterior to the insertion of the dorsal fin. Scales were taken from the right side of the juveniles, leaving the left side for scale sampling on adults. Scales were later mounted on microscope slides with the aid of a mucilage solution and covered with a cover slip. Scales were examined by use of a Bausch and Lomb Tri-Simplex microprojector.

Adult steelhead were collected during the fall upstream migration for both anchor-tagging and radio-tagging. Steelhead were collected by ADF&G personnel using hook and line or a gill net drifted downstream through the areas of fish concentration. The angling public was also cooperative in donating fish. A piece of gill net approximately 20 feet long and 6 feet

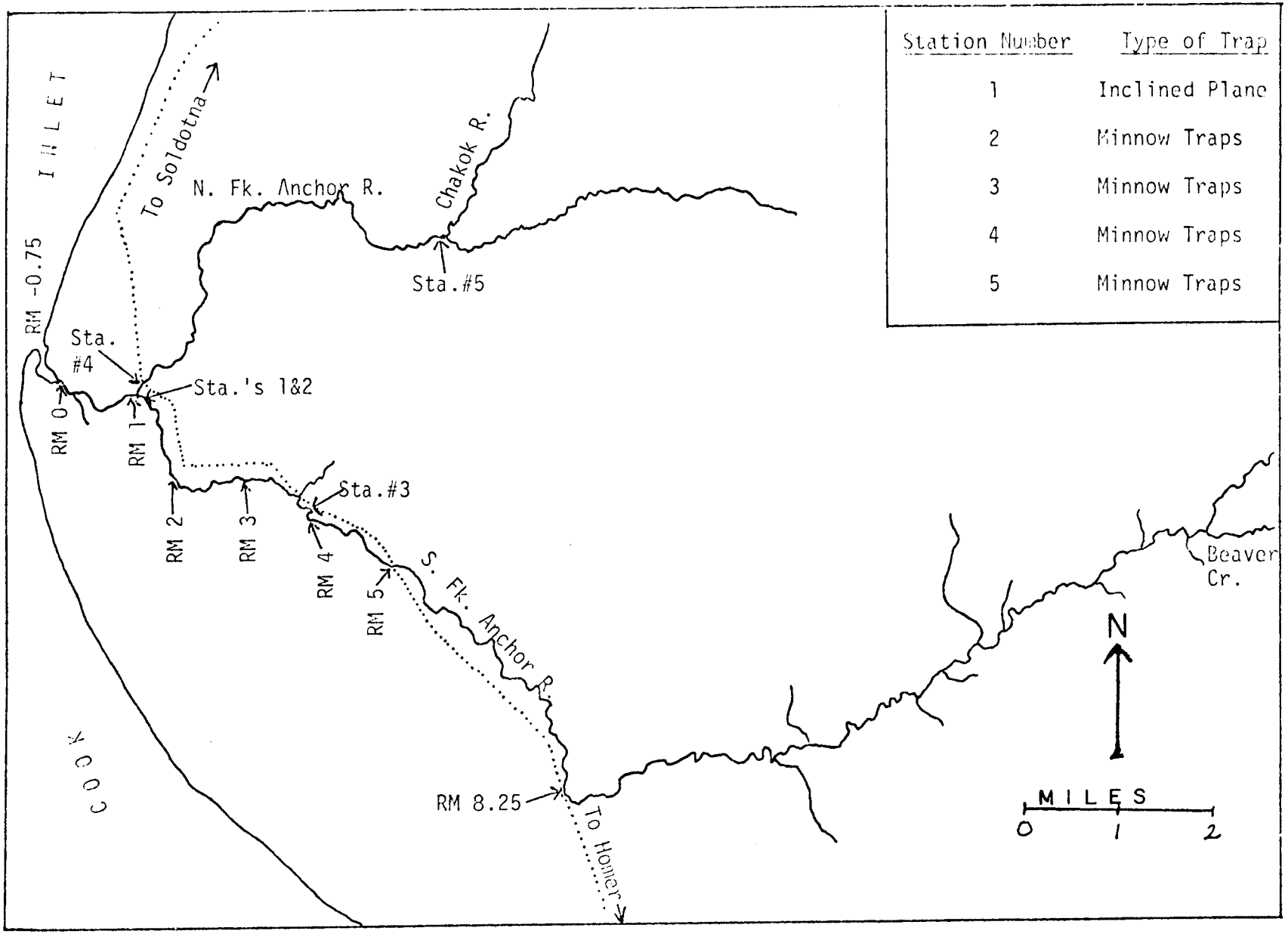

Figure 2. Map of Anchor River showing location of juvenile trapping stations, 1982.

deep was found to be the most productive and easily managed. The 3.5-inch stretched mesh allowed the steelhead to tangle their snouts and seldom, even in the case of the small ones, gill themselves. Serially numbered Floy anchor tags were inserted posterior to the dorsal fin.

Radio transmitters were inserted into the abdomen of adult steelhead by means of surgery, as part of a cooperative project with the U.S. Fish and Wildlife Service which provided tags, receivers, antenna and technical assistance. Radio-transmitters, receivers and antennas were manufactured by Telonics, of Mesa, Arizona. The radios are cylindrical, 2.5 inches long by 0.75 inches in diameter including a paraffin coating. The radios have 10-inch wire antennas and are designed to transmit a distance of approximately 1 mile over a period of 9 to 10 months. Individual radios transmit on discrete frequencies in the 150 to 152 mhz range. Radio-tagged steelhead were tracked with a receiver-scanner manufactured by Telonics. Three types of antennas manufactured by Telonics were used in conjunction with the receiver-scanner. A paddle antenna, similar in appearance to a ping-pong paddle, was used at close distances to locate the radio-tagged fish, and a handheld two-element yagi antenna was used to locate radio-tagged steelhead at greater distances. A five-element directional antenna was also mounted on a 9-foot mast in the rear of a pickup and was used to locate radio-tagged steelhead by driving along the road that closely parallels the Anchor River. Radio tracking was accomplished on foot or from the vehicle the majority of the time. Fixed-wing aircraft and helicopter were used for aerial reconnaissance of the North and South Forks of the Anchor River, Chakok River, Stariski Creek, Deep Creek and Ninilchik River when lost radios were being searched for.

Steelhead were collected from the Anchor River by ADF&G personnel to establish a brood stock at the Crooked Creek Hatchery and for enhancement of the steelhead run in the Anchor River. Fish were captured by hook and line by ADF&G personnel, gill netting and some fish were donated by anglers. Fish were collected periodically to ensure samples from all segments of the run, and taken as they were captured without regard to size. They were moved from the point of collection to the holding area in burlap sacks, bobbinet dip nets and water-filled backpack cans. The steelhead were held in a live pen in the river until sufficient numbers had been collected for the day. They were then transferred to a truck-mounted transport tank supplied with oxygen and transported by F.R.E.D. Division personnel to the Crooked Creek Hatchery where they were to be held until spawning in the spring. During the fall fishery, egg skeins were collected from steelhead anglers to determine fecundity. Fecundity was established by counting eggs in both ovaries of a few individuals and by estimates based upon proportional samples.

Scales were collected from adult steelhead during creel census, tagging operations and capture of fish for the hatchery. Samples were collected from the left side of the fish. Scales were later selected for quality, mounted on gummed cards and pressed on acetate sheets. Interpretation was aided by use of a 3M reader/printer at 29 power magnification.

Individual adult steelhead were weighed on a handheld Chatillon scale and weights were recorded to the nearest 100 grams. Fish were measured to the nearest 5 mm.

A creel census was conducted during the period from August 16 to October 31. The method employed was a modification of that described by Neuhold and Lu (1957) and was described in detail by Wallis and Balland (1981). Creel census interviews were conducted in Area 1 during two randomly selected time periods of 2.5 hours each. A vehicle count was made in Area 2 once a day, at randomly selected times, on those days a creel census was conducted in Area 1. The estimated harvest in Area 2 was based on comparative effort between Areas 1 and 2.

FINDINGS

Water Temperatures and Flows

Daily maximum and minimum temperatures recorded in the South Fork of the Anchor River are listed in Table 2.

Mean monthly waterflow rates in Anchor River for water years 1965-1982, inclusive are depicted in Figure 3. Mean monthly flows during the 1982 water year are shown by the broken line in Figure 3.

Juveniles

A resident population of rainbow trout is known to exist in the Anchor River. Most of this population occurs in the upper areas of the Anchor River, however, all the rainbow-steelhead taken in this study were captured in the lower areas of the Anchor River. They are considered to be juvenile steelhead and will be referred to as such in this report, with the realization some may be resident rainbows.

Four minnow trap stations, two on the South Fork and two on the North Fork, were established and fished on a regular basis to help determine the time of smolt migration and instream movements. Specific locations of the inclined plane trap and the established minnow trapping stations are noted in Figure 2. A summary of numbers of juvenile salmonids captured at all stations is listed in Table 3.

The inclined plane trap was fished at the same location as in 1980 and 1981. It was not effective in capturing juvenile steelhead until modified on July 5. A total of 36 juvenile steelhead were captured. All juvenile steelhead captured were less than 70 mm in length (Table 4).

A total of 582 steelhead juveniles were captured at the four established trapping stations from May 9 to September 28 during the regularly scheduled 24-hour trapping periods. The two trapping stations on the North Fork captured 296 steelhead juveniles and the two trapping stations on the South Fork captured 286 juvenile steelhead. The number of juvenile steelhead captured and their lengths are listed by weekly intervals for each station in Tables 5-8, inclusive.

Table 2. Minimum-Maximum Water Temperatures Recorded in the Anchor River, 1982, °C.

Day	May	June	July	August	September	October
	Min. Max.	Min. Max.	Min. Max.	Min. Max.	Min. Max.	Min. Max.
1	--	6 - 8	8 - 10	9 - 14	8 - 11	4 - 5
2	--	6 - 10	8 - 9	9 - 15	8 - 10	4 - 5
3	--	6 - 10	6 - 8	9 - 15	9 - 12	4 - 5
4	--	6 - 8	6 - 8	10 - 15	7 - 10	3 - 4
5	--	4 - 6	6 - 12	9 - 14	8 - 9	2 - 3
6	--	3 - 4	8 - 10	9 - 12	7 - 9	2 - 3
7	--	3 - 6	8 - 11	10 - 12	8 - 9	2 - 3
8	--	4 - 5	9 - 13	9 - 11	7 - 9	2 - 2
9	--	5 - 7	9 - 13	9 - 14	8 - 9	2 - 2
10	--	6 - 8	10 - 11	10 - 12	8 - 9	2 - 2
11	--	5 - 6	9 - 13	8 - 13	7 - 9	1 - 2
12	--	5 - 7	10 - 14	8 - 13	6 - 8	2 - 3
13	--	5 - 7	9 - 15	8 - 14	7 - 8	2 - 3
14	--	5 - 8	10 - 12	11 - 14	7 - 8	1 - 2
15	--	5 - 9	9 - 11	9 - 13	8 - 9	2 - 2
16	--	5 - 10	9 - 11	8 - 13	8 - 8	2 - 2
17	--	7 - 9	8 - 13	9 - 12	8 - 8	2 - 2
18	--	6 - 8	9 - 14	9 - 14	7 - 8	1 - 2
19	--	6 - 9	9 - 16	9 - 14	6 - 8	2 - 3
20	--	6 - 12	11 - 16	8 - 13	7 - 8	1 - 2
21	--	7 - 10	11 - 14	10 - 13	7 - 9	1 - 1
22	--	6 - 9	10 - 12	--	7 - 8	1 - 1
23	--	7 - 11	10 - 11	--	5 - 6	1 - 1
24	--	7 - 13	9 - 13	12 - 13	4 - 5	1 - 1
25	--	9 - 13	11 - 14	11 - 12	5 - 6	1 - 1
26	3 - 6	10 - 14	10 - 15	10 - 14	5 - 7	--
27	2 - 4	9 - 12	12 - 15	10 - 13	5 - 6	--
28	3 - 7	7 - 12	12 - 13	11 - 13	5 - 6	--
29	3 - 5	8 - 10	11 - 12	11 - 12	5 - 6	--
30	3 - 9	8 - 10	10 - 15	10 - 11	5 - 6	--
31	5 - 9	--	9 - 14	9 - 11	--	--

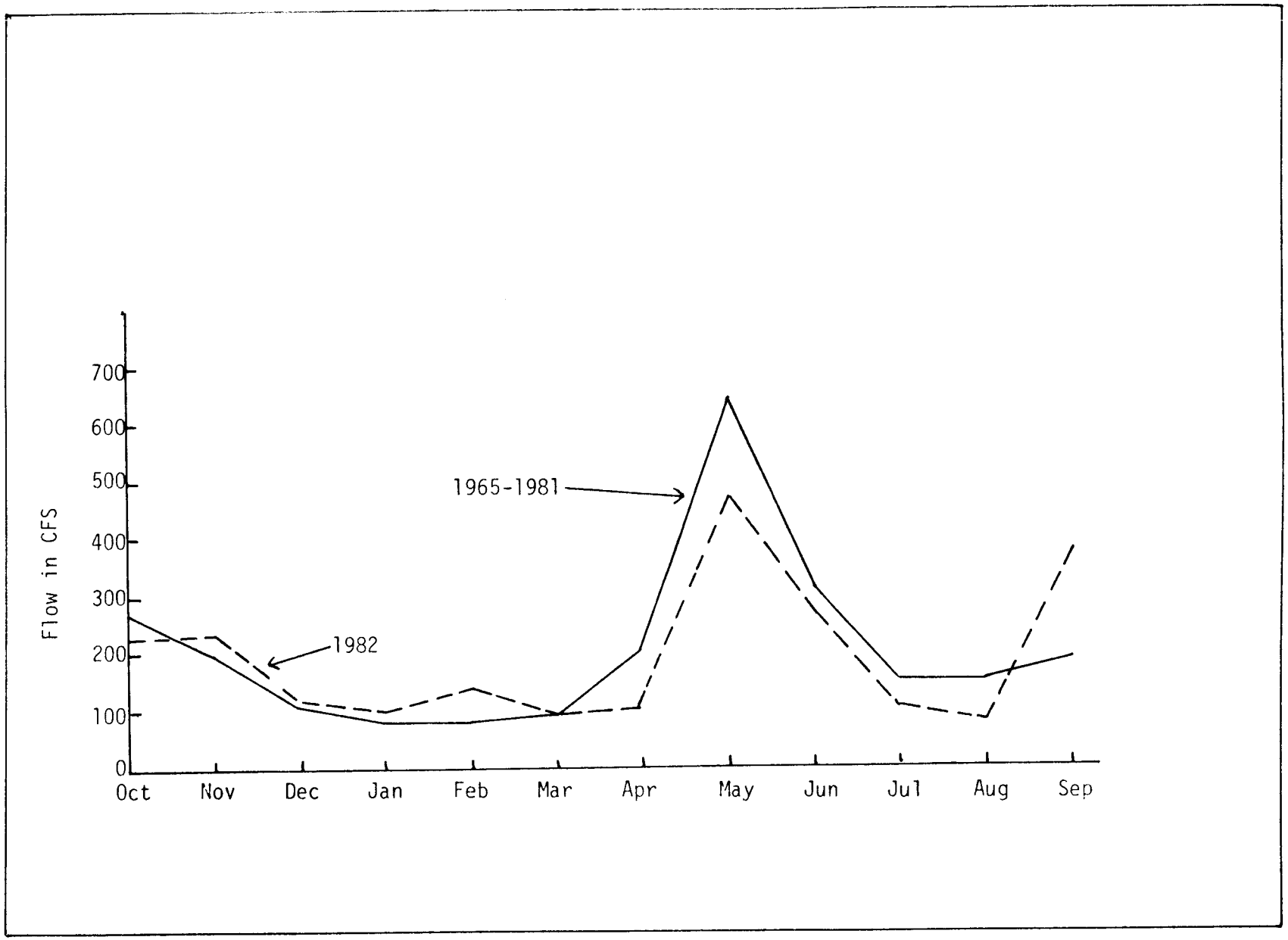

Figure 3. Mean monthly waterflows in Anchor River, 1965-1982.

Table 3. Summary of Numbers of Juvenile Salmonids Captured at Established Trapping Stations in Anchor River, 1982.

Station Number	Type of Trap	SH	DV	KS	SS
1	Inclined Plane	36	11	234	610
2	Minnow Traps	171	88	99	158
3	Minnow Traps	115	235	265	421
4	Minnow Traps	98	192	167	248
5	Minnow Traps	198	180	117	359
	Total	618	706	882	1,796

Table 4. Numbers of Juvenile Steelhead Trapped at Station 1 in Anchor River, by Weekly Period and Length Interval, 1982.

Length Interval (mm)	Weekly Period 5/23	5/30	6/6	6/13	6/20	6/27	7/4	7/11	7/18	7/25	8/1	8/8	8/15	8/22	8/29	9/5	9/12
25-29											3						
30-34											15	1	3		1		
35-39												1	1				
40-44													1				
45-49														3			
50-54														1	1		
55-59									1						2		
60-64								1									
65-69								1									
70-74																	
75-79																	
Total Measured	0			0	0	0	0	2	1	0	18	2	5	4	4	0	0
Total Captured	0			0	0	0	0	2	1	0	18	2	5	4	4	0	0

Table 5. Numbers of Juvenile Steelhead Trapped at Station 2 in Anchor River, by Weekly Period and Length Interval, 1982.

Length Interval (mm)	Weekly Period																						
	5/9	5/16	5/23	5/30	6/6	6/13	6/20	6/27	7/4	7/11	7/18	7/25	8/1	8/8	8/15	8/22	8/29	9/5	9/12	9/19	9/26	10/3
25-29																						
30-34																						
35-39																						
40-44																						
45-49																3	1	2				
50-54					5		1	1								1	4	2	2			
55-59		3	1		5	1	2	3									4	9	3			
60-64		2	1	1	7	1	1	2	1	4							2	2	3			
65-69								2	1		2							1				1
70-74							1	1	1		4	1										
75-79					1					1	1	1		1								
80-84			1											1								
85-89		1		1	1	1								2		1						
90-94		1	1	1			1		1				1	2								
95-99		1	1	1	1		1		1				1									
100-104		4		1								1		1								
105-109				1	2		1				1				1							
110-114															1							
115-119														2		1						
120-124			1	2					1													
125-129				1		1									1							
130-134				1	1						1			1		1						
135-139						1										1						
140-144				1																		
145-149	1	3		1																		
150-154		1		1																		
155-159			1			1																
160-164		1		1																		
165-169																						
170-174																						
175-179																						
180-184		1																				
185-189																						
Total Measured	1	19	7	14	23	6	8	9	3	5	9	3	2	10	3	8	11	16	8	--	--	1
Total Captured	1	19	7	14	23	6	8	9	3	5	9	3	2	10	3	8	11	16	8	--	--	1

Table 6. Numbers of Juvenile Steelhead Trapped at Station 3 in Anchor River, by Weekly Period and Length Interval, 1982.

Length Interval (mm)	Weekly Period 5/9	5/16	5/23	5/30	6/6	6/13	6/20	6/27	7/4	7/11	7/18	7/25	8/1	8/8	8/15	8/22	8/29	9/5	9/12	9/19	9/26	10/3
25-29																						
30-34																						
35-39																						
40-44																						
45-49																1						
50-54					1	3	1															
55-59			1	1		2		1	2													
60-64						1	1	2	2		1											
65-69							1		2	1	1		1									
70-74				1	2					4	2	1										
75-79					1				1		2		3		1							
80-84			1	1		3	1	1					2									
85-89			2		2	2	2	3	1				1	2		1						
90-94					2		1				1		1									
95-99					5		1			1	1		1									
100-104								2			1											
105-109						1		1			1											
110-114						1				1	1	1										
115-119								1	1				1									
120-124											2											
125-129								1														
130-134			1													1						
135-139				1						1												
140-144			1																			
145-149			1		1	1																
150-154																						
155-159																		1				
160-164											1											
165-169																						
170-174																						
175-179			1	1							3											
180-184																						
185-189										1												
Total Measured			8	5	14	14	8	12	9	9	17	2	10	2	1	3	0	1	0	--	--	0
Total Captured			8	5	14	14	8	12	9	9	17	2	10	2	1	3	0	1	0	--	--	0

Table 7. Numbers of Juvenile Steelhead Trapped at Station 4 in Anchor River, by Weekly Period and Length Interval, 1982.

Length Interval (mm)	Weekly Period 5/9	5/16	5/23	5/30	6/6	6/13	6/20	6/27	7/4	7/11	7/18	7/25	8/1	8/8	8/15	8/22	8/29	9/5	9/12	9/19	9/26	10/3
25-29																						
30-34																						
35-39																						
40-44																						
45-49																	1					
50-54																						
55-59																						
60-64																						
65-69																						
70-74									1	1												
75-79			1		1																	
80-84		1			2	1																
85-89		1	2	1	1																	
90-94	1	2		1	2				1	1												
95-99	1		2	1	1	1	1															
100-104		1		2	1																	
105-109		1	1	1					1	1						1						
110-114		1	1						1													
115-119											1											
120-124						1			1		1			1								
125-129							1		1				1									
130-134	1	1		2	1																	
135-139	1	3	1	2																		
140-144		5	1	1																		
145-149		2	1	1					1		1											
150-154	2	3	1	1						1												
155-159	1	2							1													
160-164	1	2									1											
165-169		3	1																			
170-174																						
175-179									1													
180-184									1													
185-189																						
Total Measured	8	28	12	13	9	3	2	0	10	4	4	0	1	1	0	1	1	0	0	--	--	0
Total Captured	8	28	12	13	9	3	2	0	10	4	4	0	1	1	0	1	1	0	0	--	--	0

Table 8. Numbers of Juvenile Steelhead Trapped at Station 5 in Anchor River, by Weekly Period and Length Interval, 1982.

Length Interval (mm)	Weekly Period 5/9	5/16	5/23	5/30	6/6	6/13	6/20	6/27	7/4	7/11	7/18	7/25	8/1	8/8	8/15	8/22	8/29	9/5	9/12	9/19	9/26	10/3
25-29																						
30-34																						
35-39																						
40-44																						
45-49			1			1												1				
50-54								1									1	1				
55-59								1	1		1	1						2	2			
60-64										1	1		1									
65-69					1						4		3	1								
70-74				1	1	1		2	1		2	1	1									
75-79	3	2	1	3	7	3	3	1	3		1	2	1	1	1	3						1
80-84	2	2		3	4	3	2	1	1		1		4	1								
85-89				3		1	7		3		1		3	1								1
90-94				2	1			1	1		3	1	1	1		1						
95-99				1					4		1		1				1					
100-104	1	1		1								2	2									
105-109				1	1						1		2									
110-114	1	1		2	1		1		1		1		1					1				
115-119					1				2							1	1	1				
120-124			1	3	2									1		1	1					
125-129				3					1								1					
130-134	1	1		1	1			1														
135-139																1						
140-144																						
145-149	1	1	1	3																		
150-154								1			1											
155-159									1		1											
160-164											2											
165-169																						
170-174																						
175-179																						
180-184											1											
185-189																						
Total Measured	9	9	4	27	20	9	13	9	19	1	22	7	20	6	1	7	5	6	2	--	--	2
Total Captured	9	9	4	27	20	9	13	9	19	1	22	7	20	6	1	7	5	6	2	--	--	2

Smolts were considered to be those fish 130 mm or greater, based on peaks in length frequency of captured juvenile steelhead. Steelhead smolts represented 22.3% of the catch in the North Fork and 12.9% of the catch in the South Fork. The trapping station on the North Fork at the Sterling Highway (Station No. 4) caught the greatest number of steelhead smolts (47) representing 45.6% of the total smolts captured at the four trapping stations.

The greatest numbers of smolts were captured during the week ending May 16 at all stations. Trapping success dropped to zero in early June, then a few more smolts were captured in early to mid-July. This timing pattern does not agree with observations in previous years, and it is not known if it is an accurate reflection of time of migration. The relative abundance of steelhead smolts captured by time at Station No. 4 is illustrated in Figure 4.

Length frequency of steelhead smolts captured at Station No. 4 is illustrated in Figure 5. Mean length of smolts captured was 149 mm (5.9 inches). Steelhead smolts captured at upstream trapping stations on the North and South Forks were marked with ventral fin clips in an effort to determine timing of migration when they were recaptured at the downstream stations. Eighteen steelhead smolts on the North Fork received a left ventral mark and 14 steelhead smolts on the South Fork received a right ventral mark. Only one fin-clipped fish was recaptured, and it was recaptured at the same station where it was marked.

Serially numbered flutter tags were sewn onto 114 juvenile steelhead captured in the North Fork and 76 juvenile steelhead captured in the South Fork in an effort to record instream movements of juveniles. Eleven flutter-tagged steelhead juveniles in the North Fork were recaptured once and two were recaptured twice. Ten flutter-tagged steelhead juveniles in the South Fork were recaptured once and five were recaptured twice. All the flutter-tagged fish that were recaptured were caught at the same trapping station where they had been tagged initially. Fish were recaptured from 1 to 64 days after initial tagging.

Capture of individual fish at different times provided some information on growth during the varying time periods. The increase in length of several individual fish is illustrated graphically in Figure 6. The point at the beginning of each line represents the size at time of tagging, and the second point the size at recapture. Three of the individuals were recaptured a second time. Scales were taken from most tagged juveniles, and scales from two fish were selected to illustrate the changes in scale appearance related to the increase in length of the fish. These examples are shown in Figure 7.

The length-weight relationship of juvenile steelhead captured during 1982 is illustrated in Figure 8.

Adult Data

During the period from September 20 to October 21, 37 adult steelhead were tagged with serially numbered Floy anchor tags and released. Anglers returned three tags to ADF&G. Two had been captured less than 1 week after

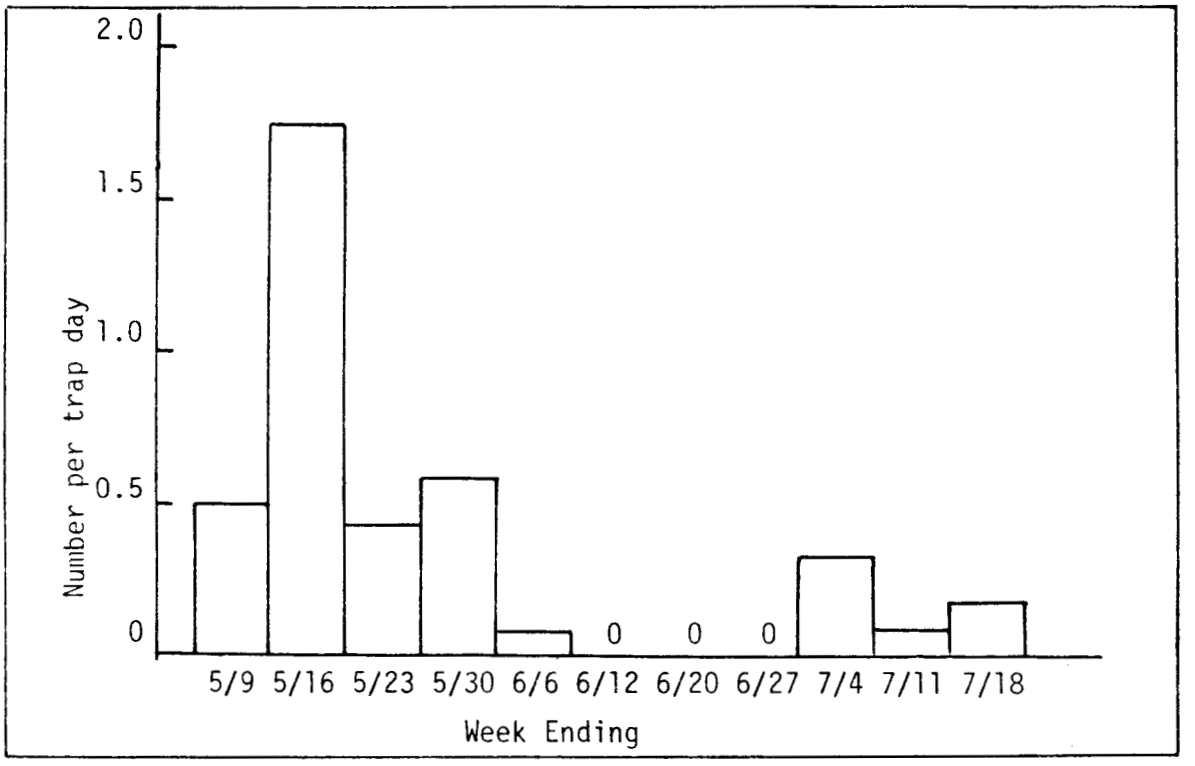

Figure 4. Relative abundance of steelhead smolts captured in minnow traps in North Fork of Anchor River, by weekly periods, 1982.

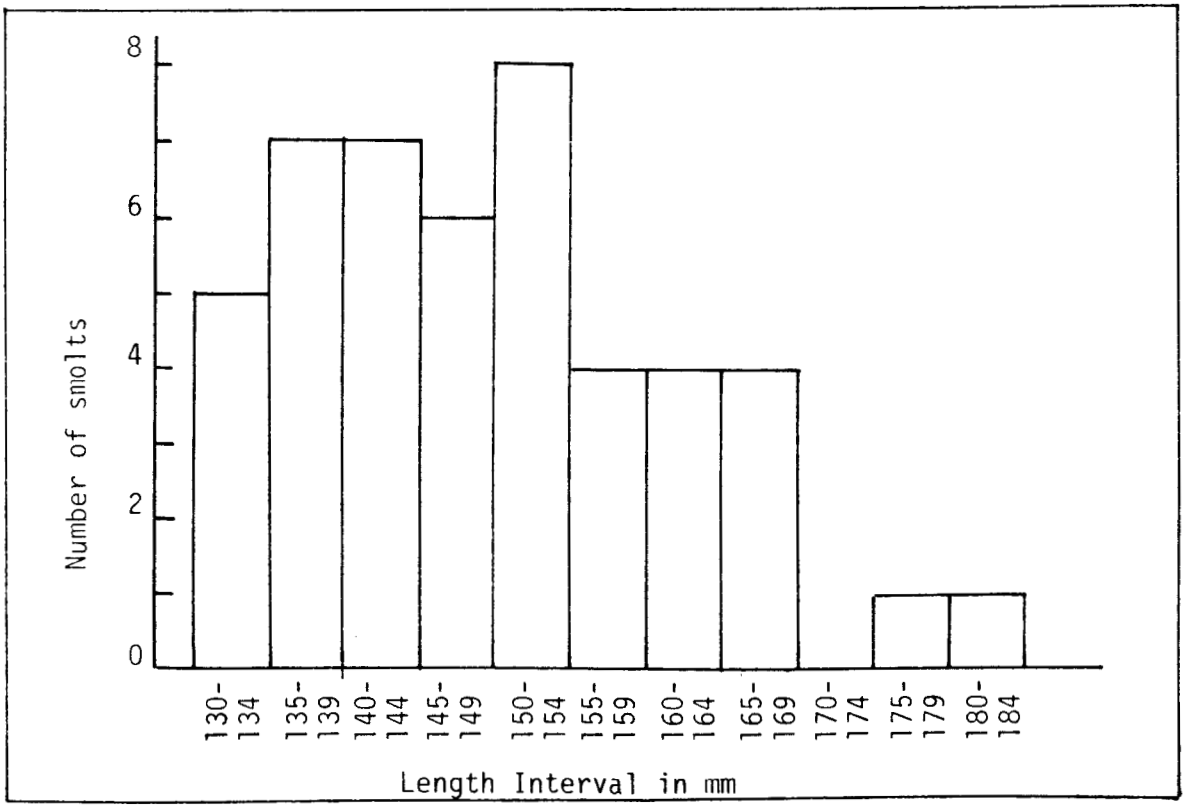

Figure 5. Length frequency of steelhead smolts caught in minnow traps in North Fork of Anchor River, 1982.

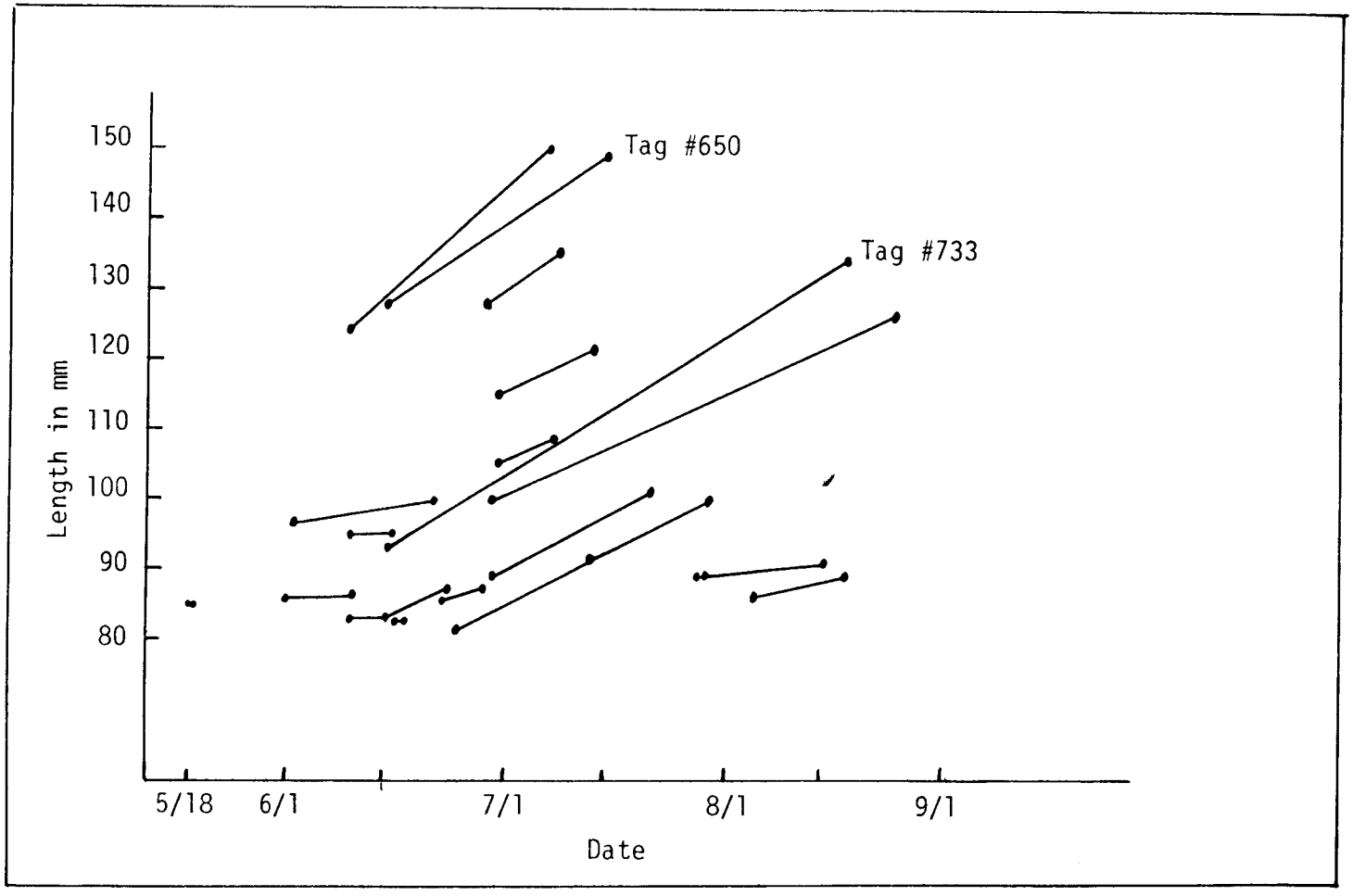

Figure 6. Increase in length of individual juvenile steelhead trout from time of tagging with flutter tags until recaptured, Anchor River, 1982.

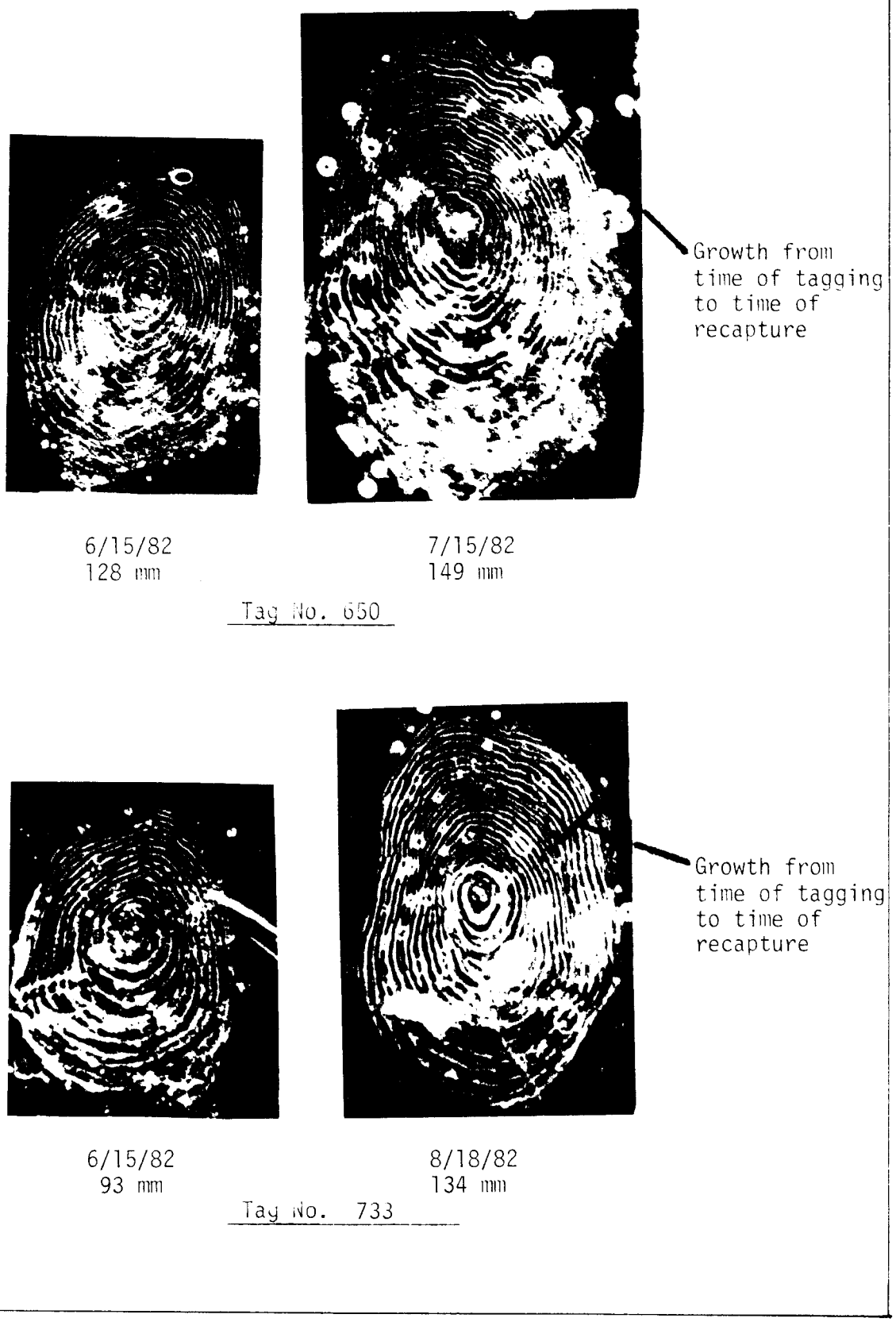

Figure 7. Prints of juvenile steelhead scales from fish tagged with flutter tags and subsequently recaptured, Anchor River, 1982.

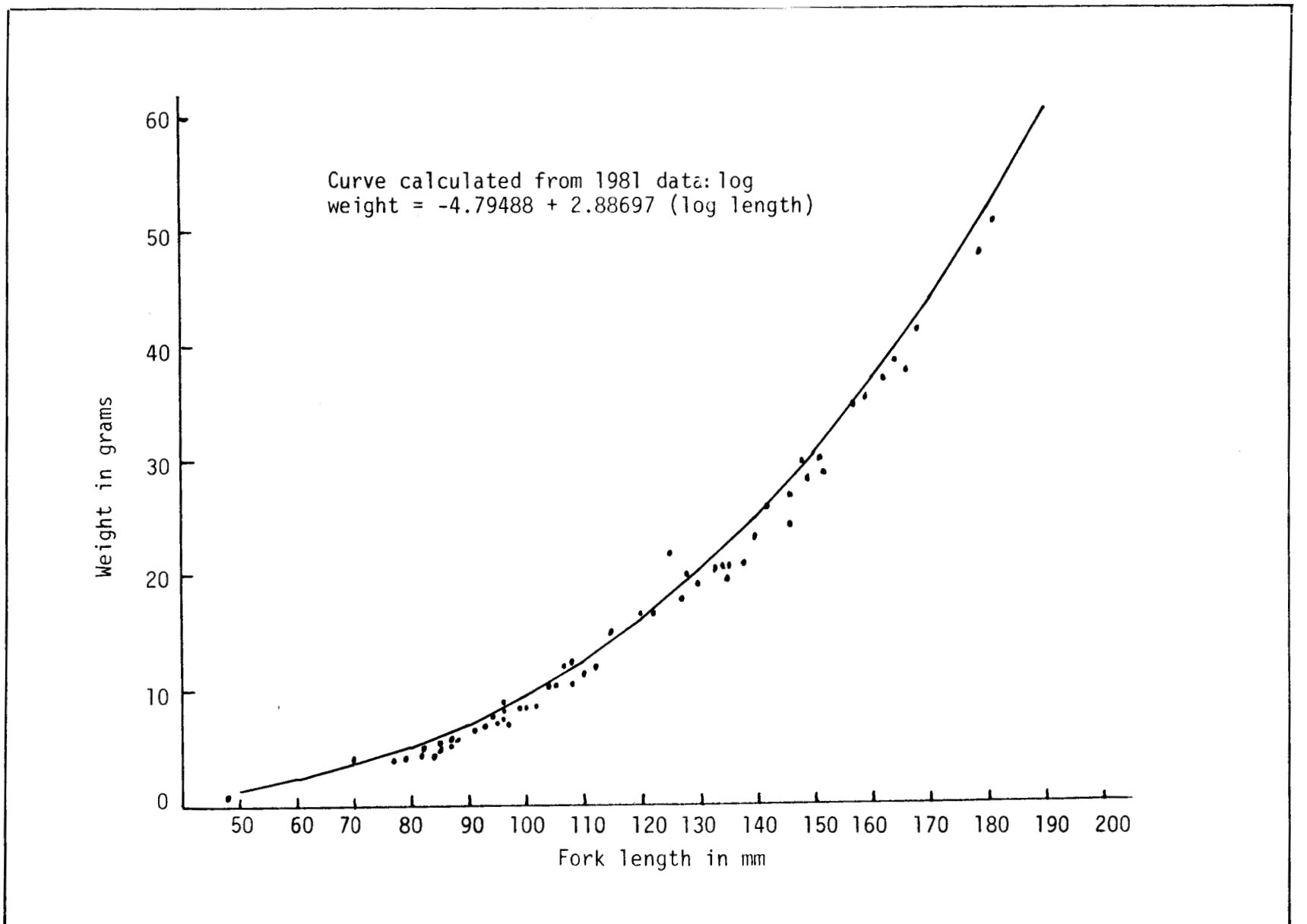

Figure 8. Length-weight relationship of juvenile steelhead trout in Anchor River, 1982.

tagging and the other was caught on an unknown date. Two of the returned tags were caught less than 1/4 mile from the tagging location, and the capture location of the third is unknown. ADF&G personnel captured two previously tagged steelhead during gill net operations; they were recorded and released. The two fish were captured less than 1 week after tagging and less than 1/4 mile from the tagging location. Inadequate recoveries of tagged fish precluded making a population estimate in 1982.

One steelhead that had been tagged and released on September 11, 1980 was captured during radio-tagging operations on September 22, 1982. A radio was inserted into the fish (Fish #2, Table 9) and it was released. Measurements and scales had not been taken in 1980, but the fish was a female, 880 mm in length in 1982.

Radio transmitters were inserted into 21 adult steelhead in an effort to determine instream movements, wintering areas and spawning areas. Details of tagging information and current status of radio-tagged fish are listed in Table 9. All the fish were captured downstream of the Dudas Hole, and were released back into the stream in the Dudas Hole. Figure 9 is a map of the lower Anchor River depicting various descriptive locations and approximate river miles; approximate river miles for upper areas of the watershed are listed in Figure 2.

Movement of radio-tagged fish are depicted graphically in Figures 10 through 13, inclusive. The scale on the y-axis is in approximate river miles. The zero-river mile point was assigned to the Slide Hole because this is the first definable site upstream of the intertidal area. Map distances downstream into the intertidal area are noted as minus values and upstream locations are plus values.

Four of the fish (#4, 12, 14, 20) were not detected after they were released. Fish #21 was detected in the Dudas Hole (site of release) the day after it was released, then was not found again. These fish may have dropped out of the river, either dead or alive, they may have been caught by anglers, or the radios may have malfunctioned.

Radios for two fish (#6 and #18) were found buried in the sand on the beach near the river mouth on October 20. Movements of both these fish from time of tagging until the radios were found are illustrated in Figure 10. Both fish moved upstream a considerable distance and appeared active for several days, then suddenly were detected in downstream areas. Radios were not in carcasses, and it is presumed that the fish died, the carcasses drifted downstream to saltwater, where the carcasses were eaten by gulls and the radios covered with sand by the surf.

Fish #2 showed a movement pattern very similar to #6 and #18 (Figure 10). It was active for a period of about 20 days, moved downstream rapidly and was last detected at the Slide Hole, the upper limit of the intertidal area. It is suspected this fish also died.

Fish #16 is suspected to be dead, also. After it was released, it dropped downstream and the radio signal has remained in the boat launch area continuously (Figure 10).

Table 9. List of Anchor River Steelhead Tagged With Radio Transmitters in 1982 and Their Current Status.

Fish No.	Date Tagged	Sex	Length (mm)	Radio Frequency	Peterson Tag No.	Status 2/1/83
1	9/22	M	690	150.365	A 187	Caught by angler 10/2/82
2	9/22	F	880	150.285	A 188	Disappeared after 20 days
3	9/22	M	590	150.144	A 189	Radio active
4	9/22	F	740	150.416	A 190	Disappeared immediately
5	9/23	M	585	150.306	A 184	Radio active
6	9/23	F	690	150.246	A 186	Fish died- Radio found
7	9/23	M	675	151.863	A 185	Radio active
8	9/23	F	580	150.015	A 191	Caught by angler 9/26/82
9	9/23	M	610	150.041	A 461	Radio active
10	9/23	F	835	150.127	A 463	Caught by angler 10/2/82
11	9/23	M	730	150.186	A 464	Radio active
12	10/5	F	660	150.364	A 177	Disappeared immediately
13	10/5	F	815	150.015	A 178	Radio active
14	10/5	M	750	150.343	A 176	Disappeared immediately
15	10/5	F	610	151.824	A 175	Radio active
16	10/5	F	775	151.833	A 181	Radio active
17	10/5	M	630	150.273	A 182	Radio active
18	10/5	F	710	150.202	A 465	Fish died- radio found
19	10/5	M	610	151.722	A 466	Radio active
20	10/5	F	715	150.223	A 467	Disappeared immediately
21	10/5	M	765	150.293	A 468	Disappeared after 1 day

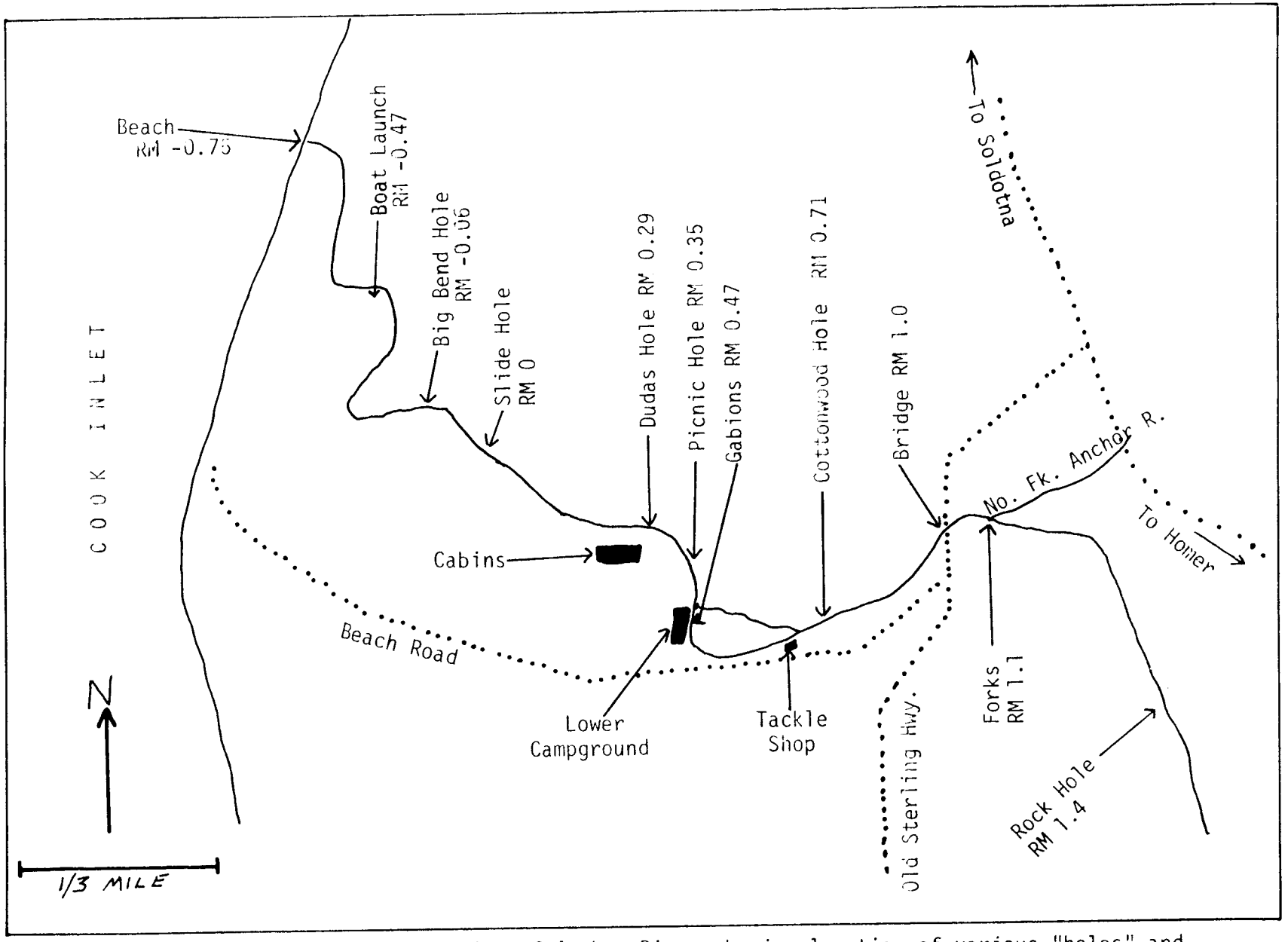

Figure 9. Vicinity map of lower portion of Anchor River showing location of various "holes" and other descriptive locations on the river.

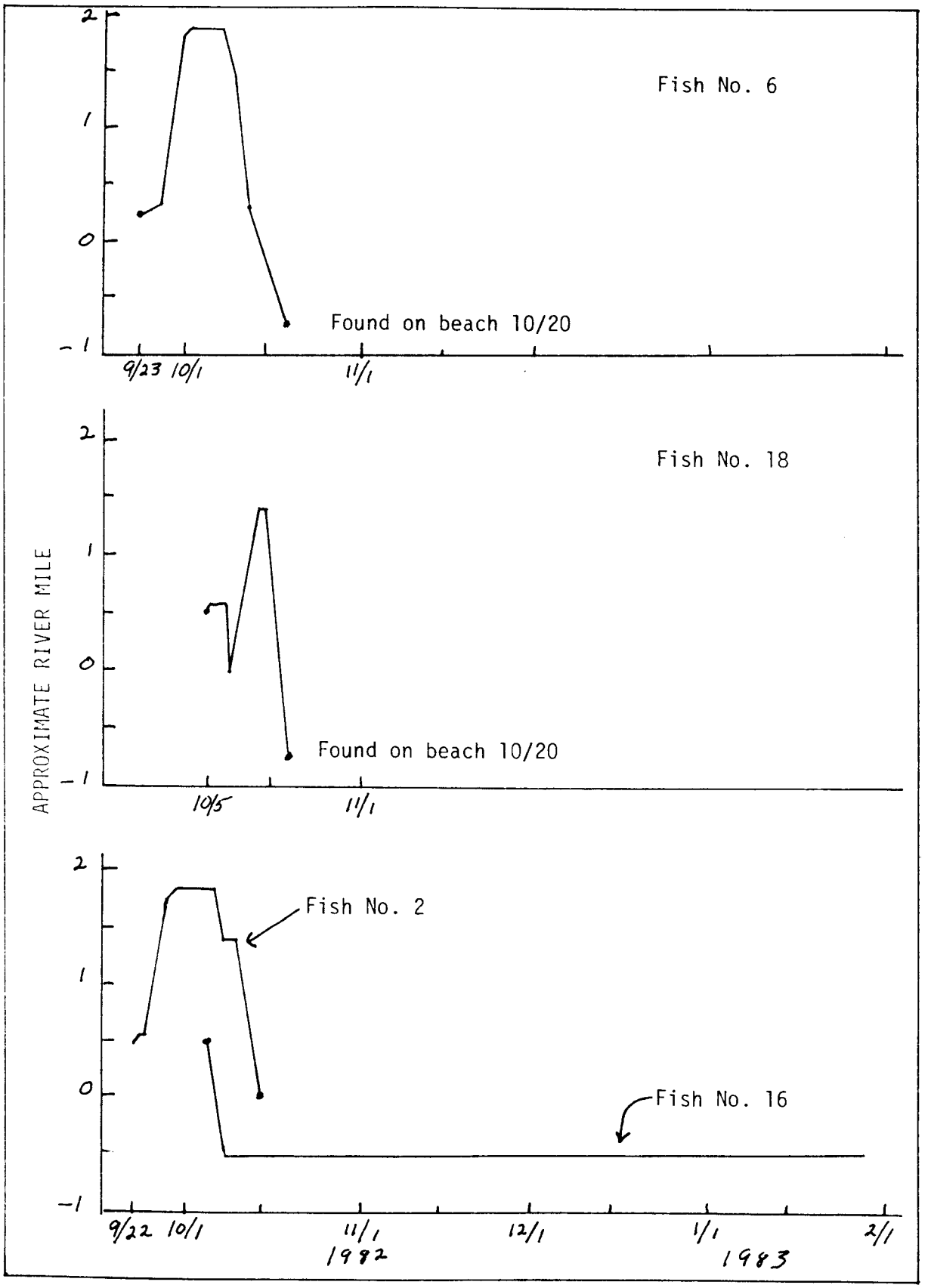

Figure 10. Graphic illustration of movement of radio tagged steelhead in Anchor River, 1982-83; Fish Numbers 6, 18, 2 and 16.

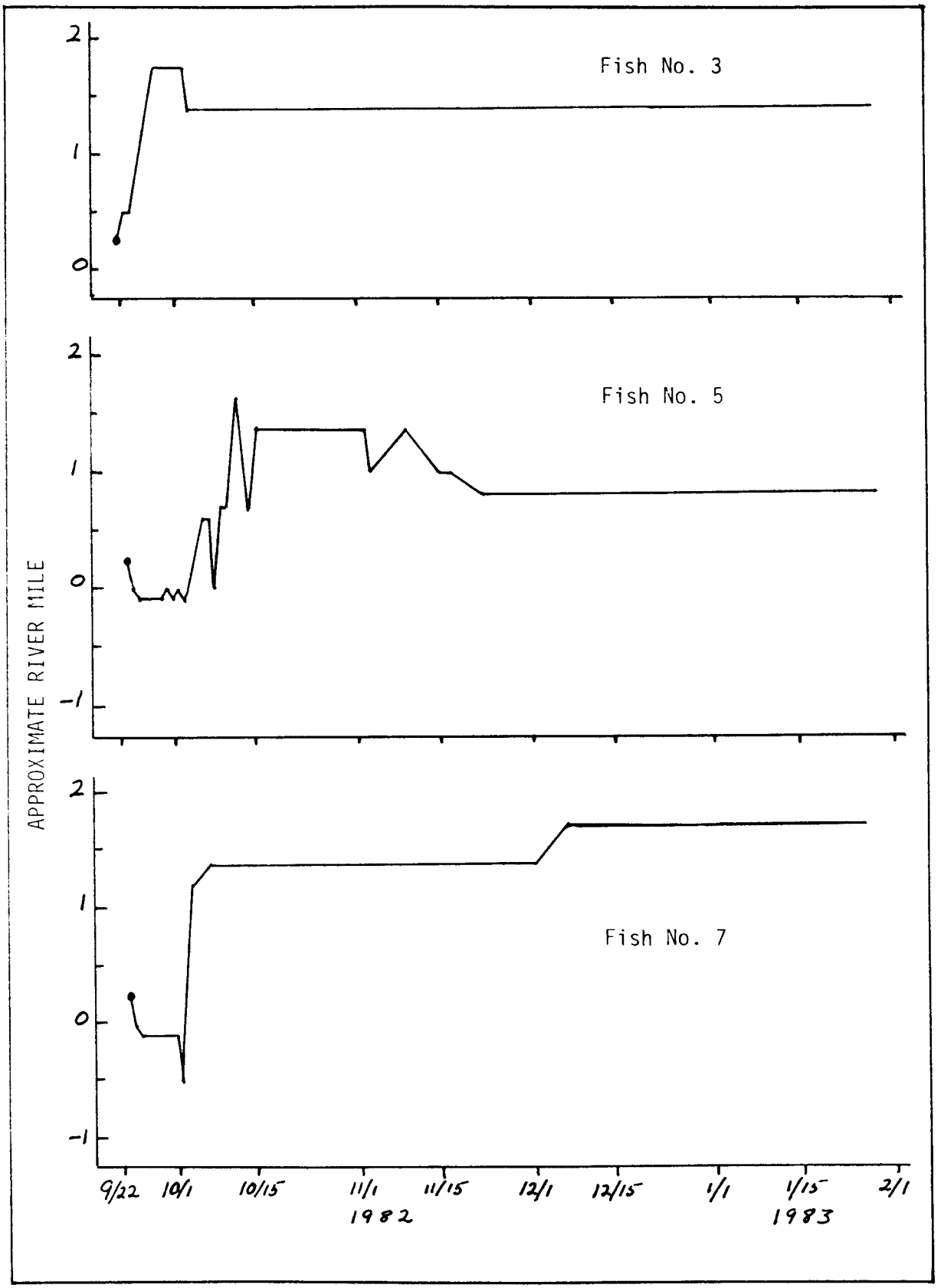

Figure 11. Graphic illustration of movement of radio tagged steelhead in Anchor River, 1982-1983; Fish Numbers 3, 5 and 7.

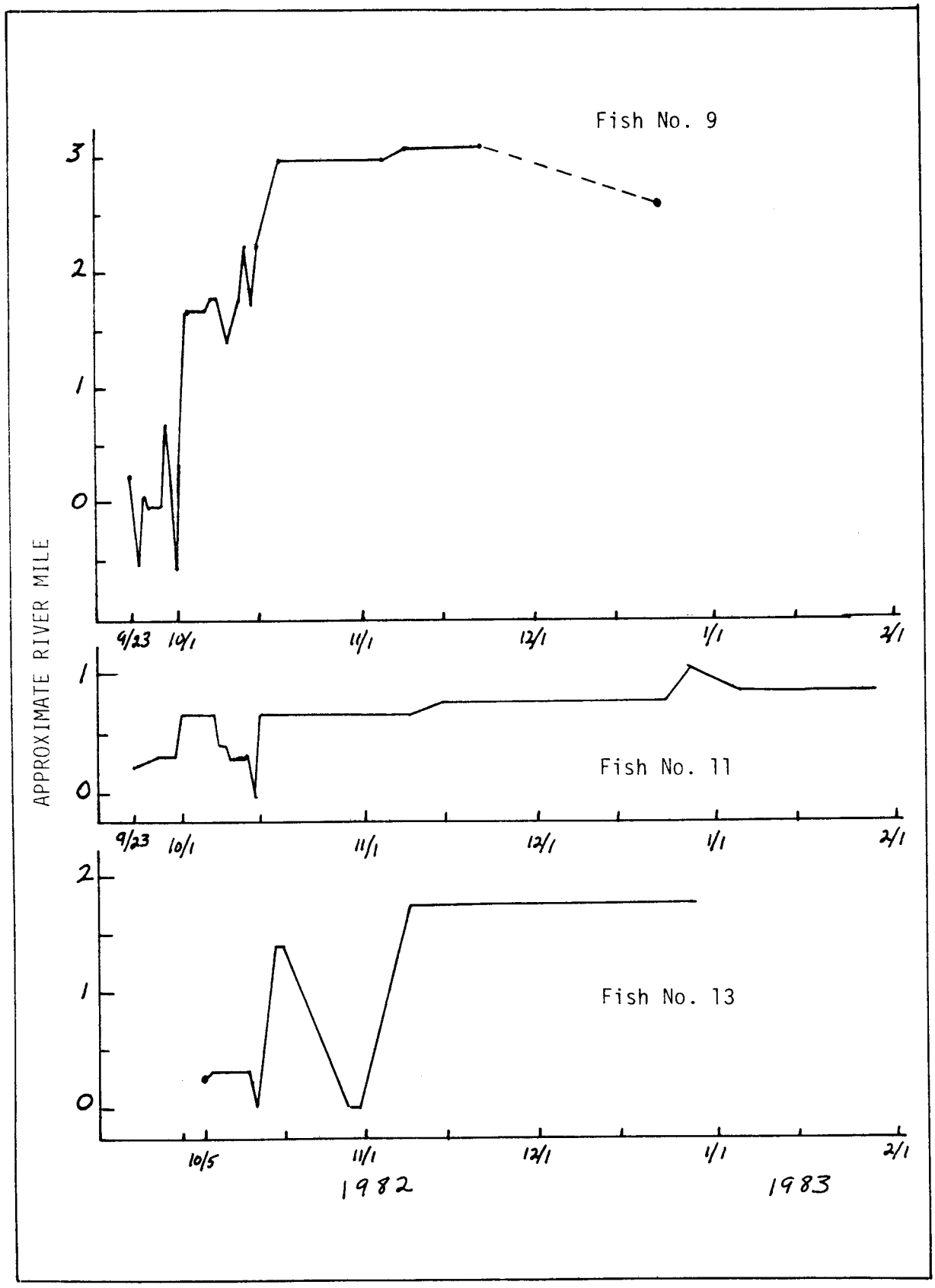

Figure 12. Graphic illustration of movement of radio tagged steelhead in Anchor River, 1982-83; Fish Numbers 9, 11 and 13.

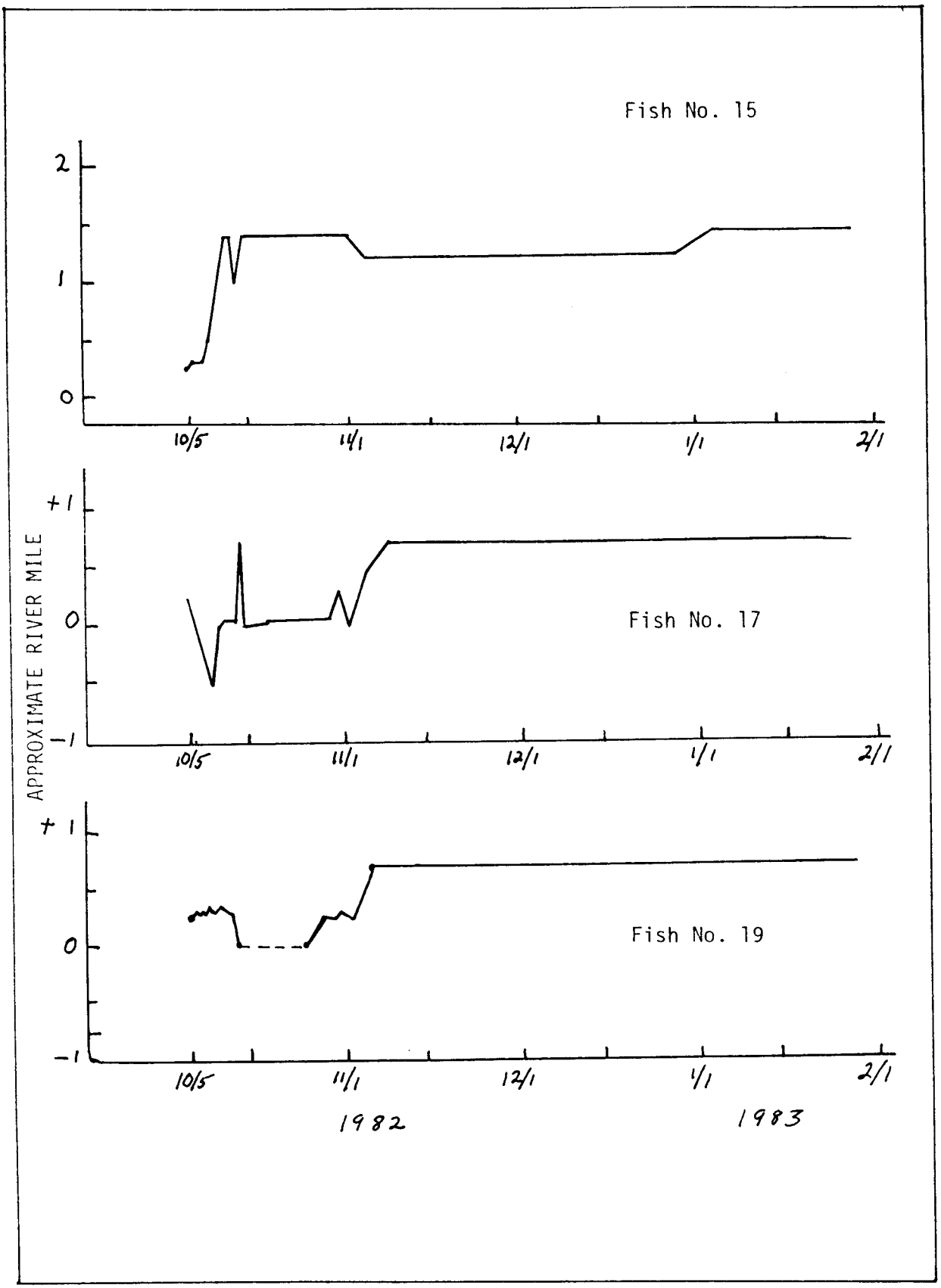

Figure 13. Graphic illustration of movement of radio tagged steelhead in Anchor River, 1982-83; Fish Numbers 15, 17 and 19.

Three fish were caught by anglers (Fish numbers 1, 8, and 10). These fish had shown slight upstream and downstream movement and were caught from 3 to 10 days following tagging.

Nine radios are still being tracked (February 1, 1983) in what are thought to be live fish. Locations of their signals by time are illustrated in Figures 11, 12 and 13.

Most of the fish moved actively upstream and downstream from time of tagging until about the first week in November and have moved comparatively little since then. Ice formed on the river in early November and this coincided with reduced movements. Most of these fish have remained very near the locations where they were when the ice cover was formed. A few of the fish showed some movement near the first of the year when the ice broke up for a short period.

Fish #19 dropped downstream after tagging and was heard at the Slide Hole on October 13; signals were not detected again until October 25. Apparently this fish moved downstream into brackish or saltwater where signals cannot be detected, then back into the river again (Figure 13).

A creel census of the summer-fall fishery was started on August 16 and terminated on October 31. A total of 2,731 anglers were interviewed and completed anglers fished an average of 3.18 hours per day. Total angler effort during this period was estimated to be 9,144 man-days. Creel census during earlier years encompassed a longer period and the effort reported in 1982 is not directly comparable to prior years. When the data are adjusted to a comparable time period, the effort in 1982 was about the same level as that for 1980 and 1981.

It was estimated that anglers harvested 375 steelhead from Anchor River during the 1982 fall fishery; the harvest is listed in Table 10 by weekly period and area. A summary of angling effort, steelhead harvest and available population estimates since 1954 is presented in Table 11.

Information obtained during interviews in 1982 showed that anglers kept only 36% of the steelhead they caught. During the years 1978-1981, anglers kept from 45% to 62% of the steelhead they caught. The harvest of steelhead in 1982 is the lowest recorded since 1968, however, if the harvest is adjusted to reflect the low percentage of fish kept, the numbers caught in 1982 are comparable to the catches in 1979, 1980 and 1981.

Scales were collected from 115 adult steelhead during creel census interviews, during radio-tagging operations and at other miscellaneous times. There were differences in sizes of fish in the three types of samples as indicated in Table 12. It is expected that fish in the creel census sample would be larger than other samples, indicating angler selection of larger fish to keep. The sample from radio-tagged fish should be the most representative of the total population because fish were taken as they were caught and were not selected for size. Samples collected from "other" fish were primarily used to obtain information for age-length and length/weight relationships; while they are not necessarily representative of any particular segment of the population, there was no deliberate selection.

Table 10. Estimated Sport Fish Effort and Harvest of Steelhead Trout From Anchor River, by Weekly Intervals and Area, July-October 31, 1982.

Week Ending	Effort Man-hours	Harvest		
		Area 1	Area 2	Total
8/22	7,797	6	1	7
8/29	4,602	10	1	11
9/5	3,552	30	5	35
9/12	2,435	62	6	68
9/19	670	19	4	23
9/26	3,029	79	13	92
10/3	1,306	25	7	32
10/10	3,120	61	6	67
10/17	726	18	3	21
10/24	1,403	10	4	14
10/31	439	3	2	5
Total	29,079	323	52	375

Table 11. Summary of Angler Effort, and Estimates of Harvest and Total Populations of Steelhead on Anchor River.

Year	Period Covered in Census	Effort Man-Days	Steelhead Estimates Harvest	/ Total Runs	Source of Data
1954	5/29-10/23	3,000	247	511	Allin (1954)
1957	5/1-10/15	5,800	50	600	Allin (1957)
1960	5/7-10/2	5,300*	400	...	Dunn (1960)
1968	7/6-10/19	3,045	102	...	McHenry (1968)
1977	Entire year	31,515	1,072	...	Mills (1979)
1978	Entire year	42,671	1,754	4,162	Mills (1980); Wallis & Hammarstrom (1979)
1979	Entire year	44,220	782	...	Mills (1981a)
1980	Entire year	33,272	841	2,388	Mills (1981b); Wallis & Balland (1982)
1981	Entire year	34,257	777	...	Mills (1982)
1982**	May-June	...	50		Estimated
	8/16-10/31	9,144	375	...	Creel census
	Total		425		

* Effort incomplete - covers period 5/7-7/14 only.
** Incomplete data, subject to revision.

Table 12. Mean Length of Adult Steelhead Collected in Different Sampling Programs on Anchor River, 1982.

Sample Origin	Number	Length (mm)		
		Mean	Range	S.D.
Creel Census				
Females	33	728	600-850	61.4
Males	31	720	540-855	91.4
Radio-Tagging				
Females	11	729	580-880	92.6
Males	10	664	585-765	67.9
Other-Misc.				
Females	17	663	530-805	78.4
Males	13	694	550-810	102.1

Total age could be determined from 100 fish and marine history was determined from all fish. A summary of age composition and lengths of all fish from all samples combined is presented in Table 13.

Thirty-eight of the 115 fish (33% of the samples) have spawned previously.

Four fish had spawned twice previously and were returning to spawn a third time, and all other repeat spawners were on their second spawning run. The percentage of repeat spawners is the highest recorded for Anchor River. Previous percentages of repeat spawners in Anchor River have been: Allin (1954), 26%; Dunn (1960), 3.5%; Redick (1968), 24.3%; McHenry (1969), 16.2%; Wallis and Hammarstrom (1979), 17.7%; Wallis and Hammarstrom (1980), 17.5%; Wallis and Balland (1981), 19.7%; Wallis and Balland (1982), 11.1%.

Lengths and weights of adult steelhead were collected during the fall steelhead fishery, and the length/weight relationship is illustrated in Figure 14. The saltwater ages of the fish are also noted in the figure.

Steelhead fecundity was determined from ovaries donated by anglers during the fall fishery. Results of the counts and estimates are listed in Table 14. Additional estimates of fecundity were available from steelhead which died at the Crooked Creek Hatchery. However, those estimates were made by a different procedure and they are not included here, even though the estimates appear comparable to those we obtained.

In early May, adult steelhead were captured by gill net in the lower portion of Anchor River to check for sexual maturity. During the first week in May, 10 steelhead were captured; two of six males had loose milt and four did not; none of the four females captured had loose eggs. It was possible to gill net the river the following week, but no steelhead were captured, although two were seen.

Forty-three adult steelhead were captured and transported to the Crooked Creek Hatchery (Table 15). Fish are to be held for spawning in the spring of 1983, eggs will be transported to Ft. Richardson Hatchery for incubation and rearing, then the resulting smolts will be planted into Crooked Creek and Anchor River.

Mortality of adults being held has been high. As of January 27, 1983, a total of 22 fish had died. Several factors may be associated with the high mortality and it is not possible to isolate any factor as the single or most important cause of death. Some fish were injured during capture, some fish were given an improper treatment at the hatchery, and it is suspected that the apparently inherent problems in holding early fish have also contributed to the mortality.

F.R.E.D. Division pathologists have examined the last five adults that died. In three of the five, bacterial kidney disease organisms have been detected, although they are not felt to be the cause of death. It is not known if the organism was present in the fish at time of transport or if they were exposed to it in the Crooked Creek Hatchery.

Table 13. Summary of Age Composition and Lengths of Anchor River Steelhead Trout; Combined Data From All Samples Taken During Fall 1982.

Age Class	Number	Length (mm) Mean	Range	S.D.
First-time spawners				
Males				
3.1	13	588	550-630	29.3
R.1	6	608	590-625	17.0
2.2	3	697	665-725	30.1
3.2	11	744	675-810	39.7
4.2	1		735	
R.2	3	735	710-765	27.8
Total	37			
Females				
2.1	2	585	580-590	7.1
3.1	6	603	550-650	33.1
4.1	1		530	
R.1	1		580	
2.2	5	707	675-755	30.9
3.2	21	690	655-735	23.5
4.2	1		735	
R.2	3	700	670-725	27.8
Total	40			
Repeat spawners				
Males				
2.1s1	1		800	
3.1s1	9	797	730-855	44.9
R.1s1	3	782	775-785	5.8
3.2s1	4	795	750-835	41.4
Total	17			
Females				
4.1s1	1		715	
2.2s1	2	760	745-775	21.2
3.2s1	11	786	700-835	46.7
4.2s1	1		800	
R.2s1	2	772	740-805	46.0
3.2s1s1	3	848	815-880	32.5
R.2s1s1	1		800	
Total	21			

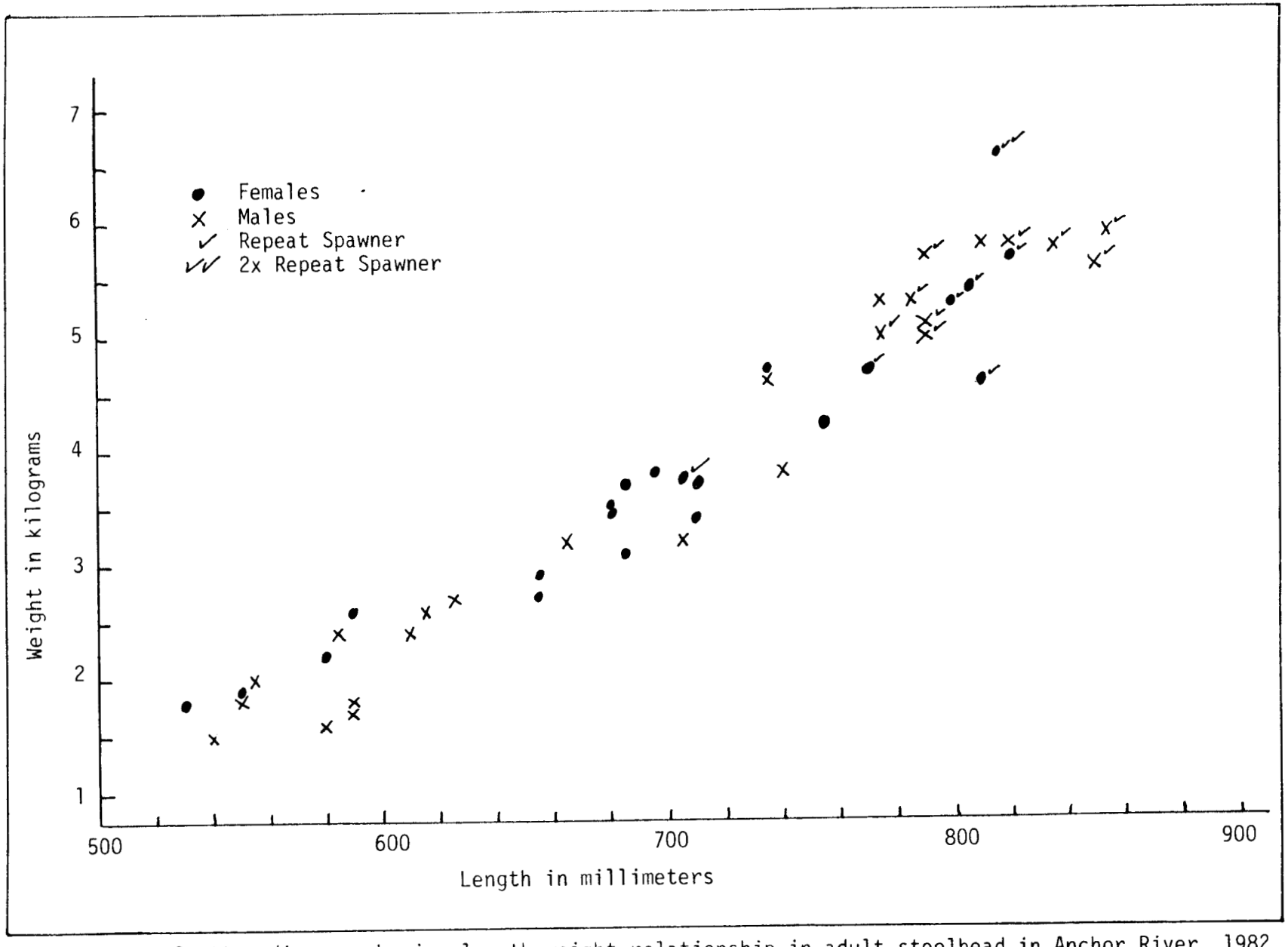

Figure 14. Scatter diagram showing length-weight relationship in adult steelhead in Anchor River, 1982.

Table 14. Fecundity of Ten Adult Steelhead Females From Anchor River, 1982.

Length (mm)	Weight (kg)	Age	Total Wt. both ovaries (g)	Sample Weight (g)	No. Eggs in sample	Total Number Eggs Estimated	Actual
725	3.9	R.2	220.9	48.7	1,340	6,078	...
745	4.6	2.2s1	200.2	63.7	1,884	5,921	...
670	...	3.2	116.4	24.7	866	4,081	...
770	4.7	3.2s1	248.1	41.8	1,264	7,502	7,088
705	...	R.2	165.5	39.2	1,233	5,206	...
655	2.7	3.2	101.8	32.5	1,362	4,266	...
735	...	3.2	195.2	49.7	1,380	5,420	...
710	3.7	2.2	222.4	68.0	1,495	4,890	4,893
735	...	3.2	280.1	71.5	1,561	6,115	6,009
695	...	3.2	313.2	88.0	1,663	5,919	5,941

Table 15. Numbers of Adult Steelhead Captured in Anchor River and Transported to Crooked Creek Hatchery, 1982.

Date	Females	Males	Total
9/8/82	4	4	8
9/9/82	2	1	3
9/22/82	5	2	7
9/28/82	4	2	6
10/6/82	5	4	9
10/22/82	5	5	10
Total	25	18	43

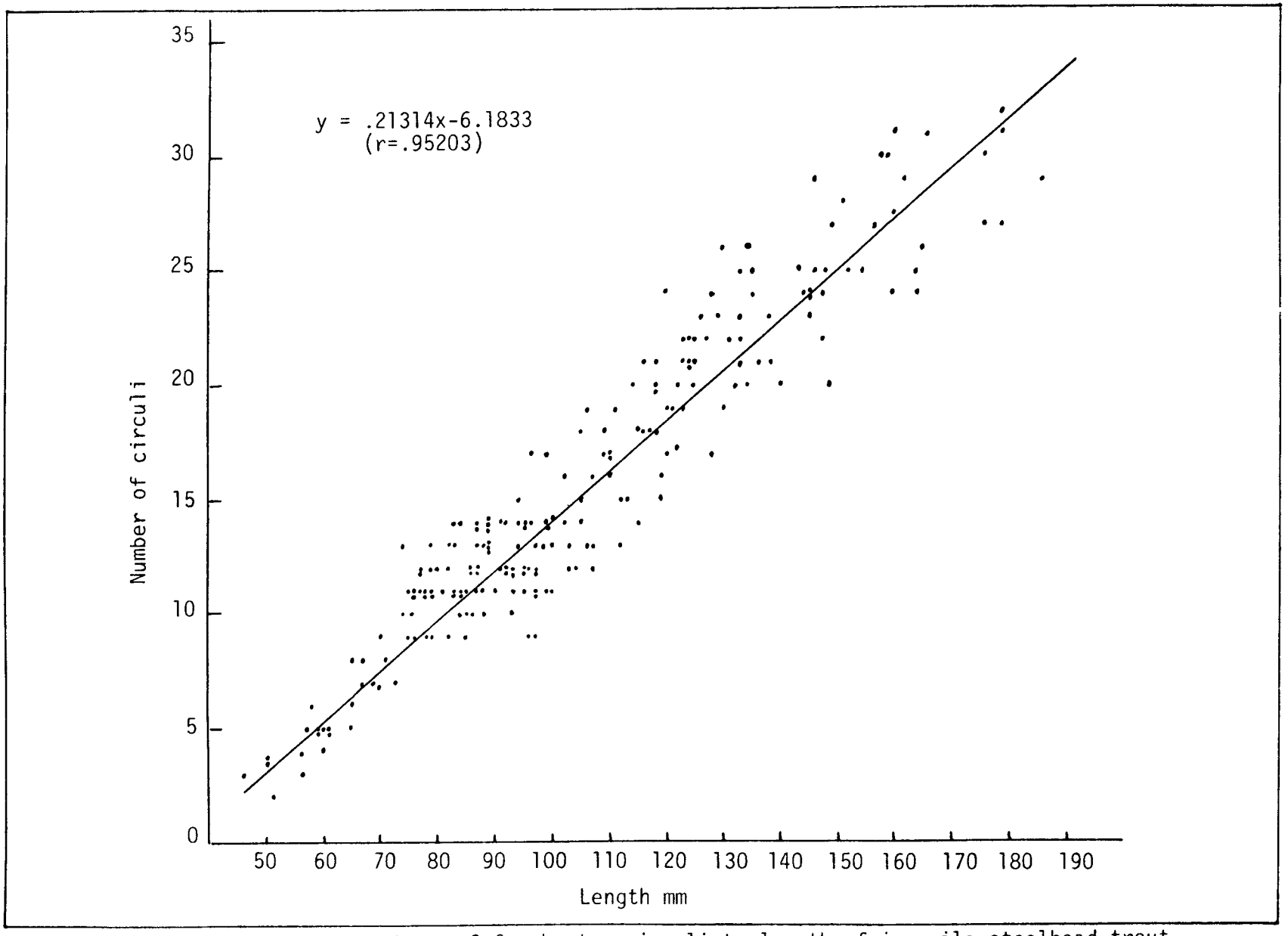

Figure 15. Relationship of numbers of freshwater circuli to length of juvenile steelhead trout in Anchor River, 1982.

Scale Analysis

Scales of juvenile steelhead were examined to establish a relationship of number of circuli to length. This relationship is illustrated in the scatter diagram in Figure 15.

Circuli in the nuclear area of adult scales were counted to provide an estimate of the size of smolts which produced adults. The frequency of freshwater circuli counts on adult scales in listed in Table 16. Mean number of freshwater circuli on adult scales was 27; this corresponds to smolts approximately 159 mm in length (Figure 15) and an average weight of 36 grams each (Figure 8). A similar analysis of adult scales in 1981 showed a mean length of 170 mm and a weight of 44 grams each (Wallis and Balland, 1982).

Numbers of circuli of "plus" growth on adult scales were also counted and their frequency is listed in Table 16. The mean number of circuli of "plus" growth, 4.9, is comparable to the mean of 5.5 observed in 1981, and corresponds to the numbers of circuli of "new" growth which would be formed in early July.

Smolts consist of 2, 3 and 4-year-old fish. Freshwater circuli counts of adult scales were separated by age of smolts to determine whether there were differences in growth rates of fish which migrated at the different ages. The mean circuli counts at each age are plotted in Figure 16. Age II smolts have the most rapid growth rate and are larger at formation of each freshwater annulus than Age III or Age IV smolts. Similarly, Age III smolts grow more rapidly than Age IV smolts. These results agree with observations made in 1981, although mean circuli counts for all age groups were slightly lower than those recorded in 1981.

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Table 16. Frequencies of Total Number of Freshwater Circuli and Number of Freshwater Circuli Formed After the Last Freshwater Annulus on Scales From Adult Steelhead in Anchor River, 1982.

Total number of freshwater circuli		Number of freshwater circuli after last freshwater annulus	
Number of Circuli	Number of Fish	Number of Circuli	Number of Fish
20	3		
21	0	0	5
22	3	1	0
23	4	2	2
24	6	3	12
25	11	4	28
26	23	5	28
27	8	6	20
28	8	7	11
29	11	8	5
30	7	9	3
31	3	10	1
32	2		
33	3	Total	115
34	1	Mean	4.9
35	0	S.D.	1.9
36	1		
37	0		
38	1		
Total	95		
Mean	27.0		
S.D.	3.2		

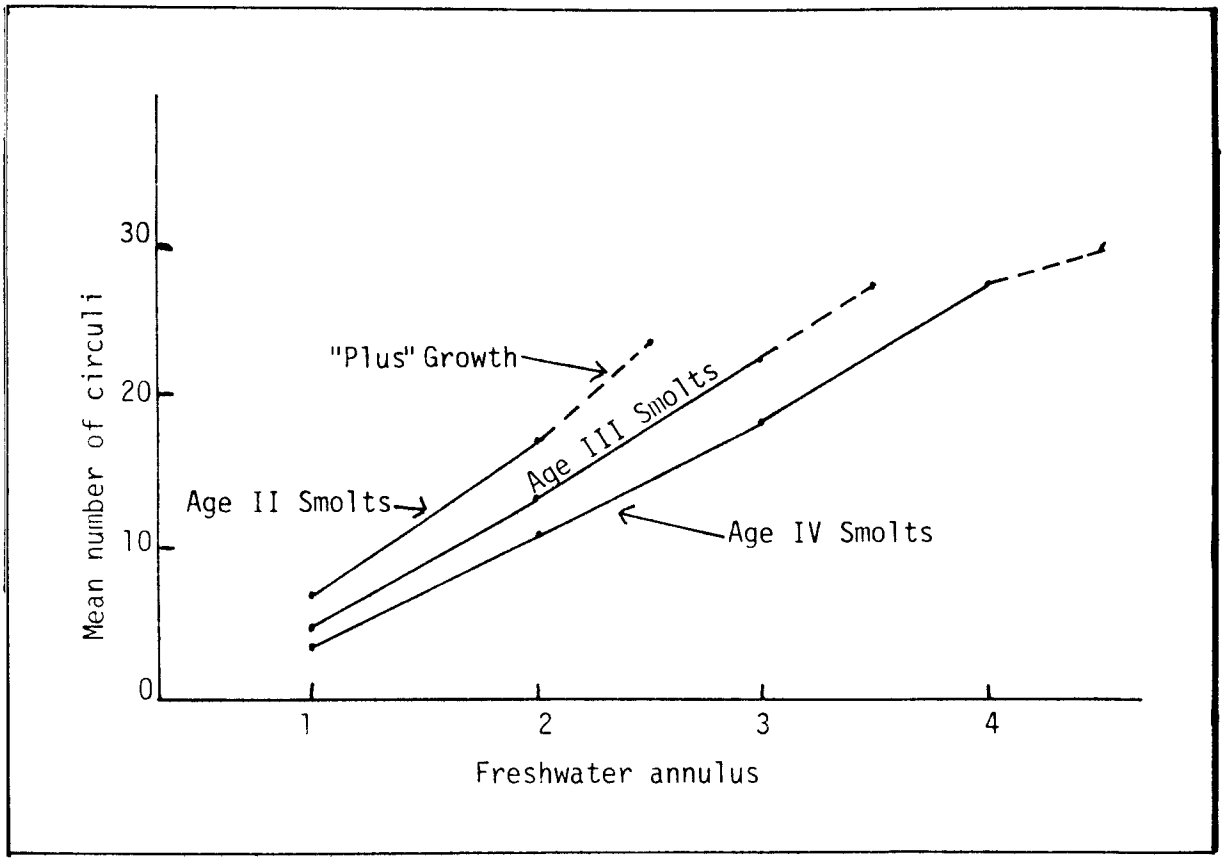

Figure 16. Mean circuli counts at each freshwater annulus and "plus" growth for Age II, III and IV steelhead smolts as determined from adult scales in Anchor River, 1982.

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